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大发现系列丛书

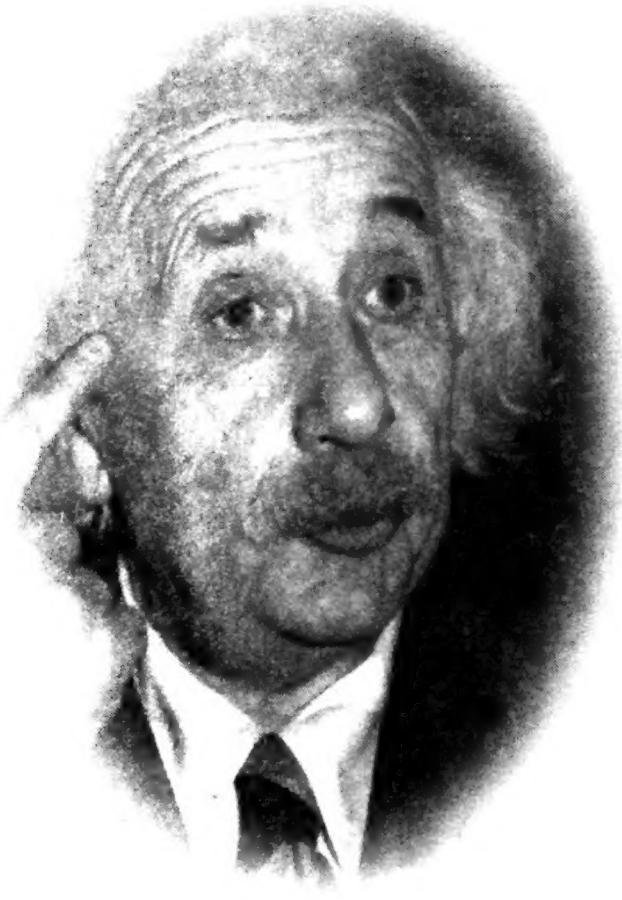
Great Discoveries

爱因斯坦的宇宙

[Einstein's Cosmos]

[美] 加来道雄 著 徐 彬 译

湖南科学技术出版社



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Einstein's Cosmos

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第一部

第一幅图景　与光速赛跑

第 1 章

科学研究的基本方法

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第 2 章

童年时代

爱因斯坦于1879年3月14日出生在德国南部的乌尔姆市。他的父亲赫尔曼·爱因斯坦（Hermann Einstein）和母亲波琳·爱因斯坦·科赫（Pauline Koch Einstein）都是犹太人。

爱因斯坦的父亲赫尔曼·爱因斯坦是一个电气工程师，他和他的兄弟雅各布·爱因斯坦（Jakob Einstein）在慕尼黑经营一家小型电气公司。爱因斯坦的母亲波琳·爱因斯坦·科赫是一个富有的谷物商人朱利乌斯·德茨巴赫（Julius Derzbacher）的女儿。她在嫁给赫尔曼·爱因斯坦之前，曾在慕尼黑的一所音乐学校学习过钢琴。她对音乐有着浓厚的兴趣，并且在家庭中营造了一个充满音乐氛围的环境。

爱因斯坦的童年时代是在慕尼黑度过的。他的家庭生活比较富裕，父母对他的教育非常重视。爱因斯坦从小就表现出对数学和科学的浓厚兴趣。他的父亲经常给他讲一些有趣的科学问题，并且鼓励他独立思考。

爱因斯坦在9岁时进入了慕尼黑的一所小学学习。他的学习成绩并不突出，甚至有些老师认为他反应迟钝。但是，爱因斯坦对数学和科学的兴趣却越来越浓厚。他经常在课余时间阅读一些科学书籍，并且自己动手做一些简单的实验。

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到“一群人的战斗”

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第 5 章

广义相对论的实验检验

1919 年 5 月 29 日，英国天文学家爱丁顿（Arthur Eddington）率领两支观测队，分别到西非几内亚湾的普林西比岛和巴西北部的索布拉尔（Sobral）镇，对日全食进行观测。

爱丁顿的观测队在普林西比岛的观测条件很不好，阴雨连绵，只拍摄了 16 张底片，其中只有 2 张底片可用。爱丁顿的助手安德鲁·克罗梅林（Andrew Crommelin）率领的观测队在索布拉尔镇的观测条件很好，拍摄了 8 张底片，其中 7 张底片可用。

爱丁顿对两个观测队的观测结果进行了仔细的分析，得出的结论是：光线在太阳引力场中的偏转角度为 1.61″，误差为 0.30″。后来，爱丁顿又对观测结果进行了修正，得出的结论是：光线在太阳引力场中的偏转角度为 1.98″，误差为 0.12″。

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注释

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[1] "A pop icon on a par...": Brian, p. 436.

[2] "In the remaining 30 years of his life...": Pais, *Einstein Lived Here*, p. 43.

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[1] "If A is success, I should say...": Pais, *Einstein Lived Here*, p. 152.

[2] "Everyone who had real contact...": French, p. 171.

[3] "tortured man, an extremely neurotic...": Cropper, p. 19.

[4] "is the most profound and the most fruitful that physics...": 同上., p. 173.

[5] "The idea of the time of magnetic action...": 同上., p. 163.

[6] "We can scarcely avoid the conclusion...": 同上., p. 164.

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[1] "A sound skull is needed...": Brian, p. 3.

[2] "It doesn't matter;...": Clark, p. 27.

[3] "Classmates regarded Albert as a freak...": Brian, p. 3.

[4] "Yes, that is true...": Pais, *Subtle Is the Lord*,

p. 38.

[5] "It is, in fact, nothing short...": Cropper, p. 205.

[6] "A wonder of such nature...": Schilpp, p. 9.

[7] "Through the reading of popular books...": 同上., p. 5.

[8] "In all these years I never...": Pais, *Subtle Is the Lord*, p. 38.

[9] "At the age of 12,...": Schilpp, p. 9.

[10] "Soon the flight of his mathematical genius...": Sugimoto, p. 14.

[11] "philosophical nonsense...": Brian, p. 7.

[12] "I love the Swiss...": Clark, p. 65.

[13] "Whoever approached him was captivated...": Folsing, p. 39.

[14] "Many a young or elderly woman...": 同上., p. 44.

[15] "Beloved sweetheart...": Brian, p. 12; Folsing, p. 42.

[16] "a work which I read with breathless attention.": Schilpp, p. 15.

[17] "such a principle resulted from a paradox upon which...": 同上., p. 53.

[18] "All physical theories, their mathematical expression notwithstanding,...": Calaprice, p. 261.

[19] "most fascinating subject at the time...": Clark, p. 55.

[20] "You are a smart boy, Einstein,...": Pais, *Sub-*

tle Is the Lord, p. 44; Brian, p. 31.

[21] "You're enthusiastic, but hopeless at physics...": Folsing, p. 57.

[22] "something very great": Sugimoto, p. 19.

[23] "I can go anywhere I want—...": Folsing, p. 71.

[24] "My sweetheart has a very wicked tongue...": Brian, p. 31.

[25] "This Miss Marie is causing me...": 同上., p. 47.

[26] "By the time you're 30, she'll be an old witch": 同上.

[27] "What's to become of her?": 同上., p. 25.

[28] "who cannot gain entrance to a good family.": 同上.

[29] "I would have found [a job]...": Thorne, p. 69.

[30] "By the mere existence of his stomach,...": Schilpp, p. 3.

[31] "I am nothing but a burden to my relatives...": Pais, *Subtle Is the Lord*, p. 41.

[32] "pissing ink": Brian, p. 69.

[33] "worldly monastery.": 同上., p. 52.

[34] "Many years later, he still recalled...": 同上., p. 53.

[35] "sad fate did not permit [her father]...": 同上.

[36] "The door of the flat was open to allow the floor,...": Sugimoto, p. 33.

[37] "private lessons in mathematics and physics": *Ibid.*, p. 31.

[38] "These words of Epicurus applied to us;...": Brian, p. 55.

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[1] "The germ of the special relativity theory...": Folsing, p. 166.

[2] "A storm broke loose in my mind.": Brian, p. 61.

[3] "The solution came to me suddenly...": 同上.

[4] "I owe more to Maxwell than to anyone": 同上., p. 152. □□□□

[13] "Since the mathematicians have attacked the relativity...": Clark, p. 159.

[14] "might have remained stuck in its diapers.": Cropper, p. 220.

[15] "As a student he was treated contemptuously by the professors...": Brian, p. 73.

[16] "The festivities ended in the Hotel National,...": 同上., p. 75.

[17] "He appeared in class in somewhat shabby attire,...": Cropper, p. 215.

[18] Another paradox involves two objects. each shorter than the other. □□□□

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[16] "Unbelievable what Europe has unleashed in its folly.": Folsing, p. 343.

[17] The war and the great mental effort necessary...:
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human thought...": Clark, p. 290; Parker, p. 124.

[6] "There's a rumor...": Parker, p. 126.

[7] "Don't be modest Eddington...": 同上.

[8] "Revolution in Science—New Theory of the Universe—...": Folsing, p. 445.

[9] "All England is talking...": 同上.

[10] "Today in Germany I am called a German man of science,...": 同上., p. 451.

[11] "At present, every coachman and every waiter...": 同上., p. 343.

[12] "Since the flood of newspaper articles...": Cropper, p. 217.

[13] "This world is a curious madhouse...": 同上., p. 217.

[14] "I feel now something like a whore...": Brian, p. 106.

[15] "seem to have been seized with something like intellectual panic...": 同上., p. 102.

[16] "The supposed astronomical proofs...": 同上., p. 101.

[17] "I have read various articles on the fourth dimension,...": 同上., p. 102.

[18] "cross-eyed physics... utterly mad...": 同上., p. 103.

[19] "A new scientific truth does not as a rule prevail...": Folsing, p. 199.

[20] "Great spirits have always encountered violent opposition...": Pais, *Einstein Lived Here*, p. 219.

[21] "could have been predicted from the start—...": Sugimoto, p. 66.

[22] "we should not drive away such a man...": Brian, p. 113.

[23] He had finally rediscovered his Jewish roots...: □□□□

Einstein Lived Here, p. 152.

[33] "If a German were to discover a cure for cancer...": Sugimoto, p. 63.

[34] Previously, hehad even advocated killing Rathenau.: 同上., p. 64.

[35] "it was a patriotic duty to shoot...": Clark, p. 360

[36] "Once, a mentally unbalanced Russian immigrant,...": Brian, p. 150.

[37] "Life is like riding a bicycle...": 同上., p. 146.

[38] "He spent all his time...": Brian, p. 144.

[39] By the 1920s and 1930s, Einstein had emerged as a giant...□□□

Lived Here, p. 184.

[42] "The people applaud me...": Sugimoto, p. 122.

[43] "I could have imagined...": Brian, p. 205.

[44] "It was interesting to see them together—...": Calaprice, p. 336.

[45] "Is not all of philosophy as if written in honey?...": Pais, *Subtle Is the Lord*, p. 318.

[46] "The world, considered from the physical aspect,...": Pais, *Einstein Lived Here*, p. 186.

[47] "Morality is of the highest importance—...": Calaprice, p. 293.

[48] "Science without religion is lame,...": Pais, *Einstein Lived Here*, p. 122.

[49] "The most beautiful and deepest experience...": 同上., p. 119.

[50] "If something is in me which can be called religious,...": Sugimoto, p. 113.

[51] "I'm not an atheist...": Brian, p. 186.

□ **6**□ □□□ □ □ □ □ □

[1] "If the matter was evenly...": Misner et al., p. 756.

[2] "My husband does that...": Croswell, p. 35.

[3] "There should be a law of Nature...": Thorne, p. 210.

[4] "there is not much hope...": Petters et al., p. 7.

[5] "is of little value, but it makes the poor guy [Mandl] happy": 同上.

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[1] "They do not shake my strong feeling...": Pais, *Subtle Is the Lord*, p. 23.

[2] "It is a masterful symphony": Parker, p. 209.

[3] "no significance for physics.": Pais, *Subtle Is the Lord*, p. 343.

[4] "The idea of achieving...": 同上., p. 330.

[5] "The formal unity of your theory is startling.": 同上., p. 330.

[6] "You may be amused to hear...": Pais, *Einstein Lived Here*, p. 179.

[7] "It is not even wrong.": Cropper, p. 257.

[8] "I do not mind...": 同上.

[9] "What you said...": 同上.

[10] "Some people have very sensitive...": 同上.

[11] "The more success...": Calaprice, p. 231.

[12] "Like the dark lady who inspired Shakespeare's sonnets,...": Moore, p. 195.

[13] "This extra minus sign, argued Dirac, made possible..."□□□

[16] "the motion of particles follows...": Folsing, p. 585.

[17] "Quantum mechanics calls for a great deal of respect...": 同上.

[18] "Heisenberg has laid a big quantum egg...": Brian, p. 156.

[19] "cobbler or employee in a gaming house": Ferris, p. 290.

[20] "Physicists were beginning to...": 爱因斯坦对于□□□

Brian, p. 306.

[25] "I don't like it,...": Kaku, *Hyperspace*, p. 280.

[26] "Does the moon exist...": 同上., p. 260.

[27] "I have thought a hundred times as much about the quantum problems...": Calaprice, p. 260.

[28] "spooky action-at-a-distance": Brian, p. 281.

[29] "I was very happy that in that paper...": 同上.

[30] "We dropped everything;...": Folsing, p. 698.

[31] "most successful physical theory of our period": Pais, *Einstein Lived Here*, p. 128.

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[1] "This means that I am opposed to the use of force...": Cropper, p. 226.

[2] "The purpose of this publication is to oppose...": Sugimoto, p. 127.

[3] "Turn around, you will never see it again.": Pais, *Einstein Lived Here*, p. 190.

[4] "Under today's conditions, if I were a Belgian,...": Folsing, p. 675.

[5] "The antimilitarists are falling on me...": 同上.

[6] "I had hoped to convince him...": Cropper, p. 271.

[7] "People say that I get attacks of nervous weakness,...": Brian, p. 247.

[8] "I failed to make myself understood...": Cropper, p. 271.

[9] "He could have been seriously hurt by this ferocious

beating,...": Moore, p. 265.

[10] "Princeton is a wonderful little spot...": Cropper, p. 226.

[11] "large wastebasket... so I can throw...": Brian, p. 251.

[12] Two Europeans, on a bet...: Parker, p. 17.

[13] "grave heredity": Folsing, p. 672.

[14] "I have seen it coming,...": 同上.

[15] "utterly ashen and shaken": Brian, p. 297.

[16] "severed the strongest tie he had...": 同上.

[17] "I have got used extremely well...": Folsing, p. 699.

[18] "It might be possible, and it is not even improbable,...": 同上., p. 707.

[19] "All bombardments since...": 同上., p. 708.

[20] "Assuming that it were possible to effect...": 同上.

[21] "as firing at birds in the dark,...": 同上., p. 709.

[22] "the rays released... are in turn...": 同上., p. 708.

[23] "the country that exploits it first...": 同上., p. 712.

[24] "anyone who expects a source of power...": Pais, *Inward Bound*, p. 436.

[25] "Oh, what fools we all have been!" Cropper, p. 340.

[26] "do not justify the assumption...": Folsing,

p. 710.

[27] "Some recent work by E. Fermi and L. Szilard,...": 同上., p. 712.

[28] "This requires action": 同上.

[29] "I will have nothing...": Cropper, p. 342.

[30] "I would rather walk naked...": 同上.

[31] "I wish very much that I could place...": Folsing, p. 714.

[32] "In view of his radical background,...": 同上.

[33] "□□□

or the poets...": Weinberg, p. 153.

[39] "I have become a lonely old fellow...": Brian, p. 331.

[40] "I must seem like an ostrich...": Pais, *Subtle Is the Lord*, p. 465.

[41] "I am generally regarded as a sort of petrified object...": 同上., p. 162.

[42] "Oppenheimer made fun...": Brian, p. 377.

[43] "This is not a jubilee book for me,...": Cropper, p. 223.

[44] "Anything really new is invented...": 同上.

[45] "Nature shows us only...": Calaprice, p. 232.

[46] "Subtle is the Lord,..." 同上., p. 241.

[47] "I have second thoughts...": 同上.

[48] "From 1954 to the end of his life,...": Pais, *Inward Bound*, p. 585.

[49] "We in the back...": Kaku, *Beyond Einstein*, p. 11.

[50] "It was an uncanny encounter of two giants...": Cropper, p. 252.

[51] "What I admired most about Michele was the fact...": Overbye, p. 377.

[52] "It is tasteless to prolong life artificially...": Calaprice, p. 63.

□ **9** □ □□□ □ □ □ □ □ □ □ □ □ □

[1] "The very study of the external world...": Crease and Mann, p. 67.

[2] "Science cannot solve the ultimate mystery...":

Barrow, p. 378.

[3] This would be the acid test. □□□□□□□□□□□□□□ EPR□□□□□□□□□□□□□

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Great Discoveries

“所有的物理学理论……都必须能够以儿童都能明白的表述讲清楚。”

——阿尔伯特·爱因斯坦

爱因斯坦的理论有着无穷的含义。但他却是通过简单的物理图景进行思考的——加速的火车、坠落的电梯、火箭、走动的钟表等等。对宇宙的认知产生重大影响的相对论，正是源自两幅这样简单的图景。第一幅图景从爱因斯坦16岁起就一直萦绕在他脑际。在这幅图景中，他考虑的是如果自己追随一束光运动，光会是什么样子。这最终导致了相对论和 $E = mc^2$ 这一方程式的诞生。这个方程式揭示了恒星的秘密。

在伯尔尼专利局工作的时候，爱因斯坦坐在椅子上，想起了第二幅图景：如果自己落下去，会出现什么情景？这一有点滑稽的情景使他想到空间和时间的弯曲，从而超越了牛顿学说中神秘的引力。这一图景反过来也使我们了解了黑洞和大爆炸。

爱因斯坦之所以未能建立将所有自然法则纳入一体的统一论，其根源在于他一直未能找到第三幅图景。但是加来道雄雄辩地证明了爱因斯坦晚年学术生涯中所产生的一些观点，虽然曾被认为和物理学无关，却在后来不断催生出新的科学领域、新的技术，甚至还包括好几个诺贝尔奖。另外，他那种探索的精神仍然存在于弦理论之中。现在弦理论在理论物理学中处于核心位置。

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